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19. KEY WORDS (Continue on reverse side if necessary and identify by block number)

Functions	Procedure	Motivation	Adaptability
Out commas	Principle	Feasability	Implementability
Verbal Information	Cognitive Strategies	Utility	
Intellectual Skills	Affective Domain	Flexibility	
Concept	Pychomotor Domain	Cost-Efficiency	

20. ABSTRACT (Continue on reverse side if necessary and identify by block number)

Contains additional guidance in support of Interservice Procedures for Instructional Systems Development (IPISD) in the form of prescriptions and guidelines.

An organizational scheme is utilized to classify the instructional strategies reviewed according to when they should be used.

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INSTRUCTIONAL DESIGN LITERATURE REVIEW

for EDeP

(Extended Design Procedure)

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Disclaimer

The views, opinions, and/or findings contained in this report are those of the authors and should not be construed as an official Department of the Army position, policy or decision, unless so designated by other documentation.

INTRODUCTION

The (ultimate) purpose of this literature review was to help provide additional guidance in support of the design activities of the IPISD (Interservice Procedures for Instructional Systems Development). Toward this end, the authors were commissioned by TRADOC to develop a set of prescriptions and guidelines (the Extended Design Procedure) that would augment the IPISD's design procedures. As the initial phase of that effort, this literature review was intended to provide a knowledge base for the creation of the Extended Development Procedure (EDeP). Our desire was that EDeP incorporate as much useful knowledge about instructional design as possible. Hence the objective of the literature review was to identify as much of such knowledge as could be found within the resource constraints of the contract.* This literature review is, therefore, a compilation of the work of many prominent theorists and researchers in the field of instructional design.

Classification Scheme

Since the purpose of this review was to provide a knowledge base for instructional design prescriptions, we early recognized the need for an organizational scheme that would classify the instructional strategies reviewed according to _when_ they should be used. The following section describes this classification scheme. Reading this section may be facilitated by referring to Figure 1.

* After the literature review phase of the contract was over, the authors continued to review much literature, especially literature related to the various approaches (lecture, tutoring, etc.). Those additional reviews are not included here.

Insert Figure 1 about here

Outcomes

The field of instructional design primarily concerns itself with specifying sets of strategies or "events" of instruction to accomplish desired learning outcomes. Different instructional theories prescribe different strategies. Instructional theories also state (or ought to state) the conditions under which those strategies should be used. In our review and analysis, we noticed that most instructional theorists have identified instructional (learning) outcomes as the most useful basis for prescribing their strategies. Gagne, Gropper, Collins and Stevens, Merrill, and Markle are examples of this trend. Thus, our classification scheme also uses outcomes as the major basis for categorizing instructional strategies (see the left-hand side of Figure 1).

The outcomes dimension of the classification scheme is based on Robert Gagne's classification of learning outcomes. All five of Gagne's domains of learning are included: Verbal Information, Intellectual Skills, Cognitive Strategies, Attitudes, and Psychomotor Skills. However, many presoriptions for Psychomotor Skills have been included within the intellectual skills domain because Landa has argued convincingly that motor procedures should be taught with the same methods as cognitive procedures.

Learning outcomes which emphasize Verbal Information would perhaps be more accurately labelled as remember-level outcomes because non-verbal information also falls within this category. There are a variety of Intellectual Skills outcomes, and several classification schemes exist. Based on our experience, we believe that Merrill's content types are most

Author:

Publication:

Classification of Strategies Prescribed

| Functions: Outcomes: | Organizational | | | | | | Managmt | Delivry |
| | Micro | | Macro | | | | | |
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
Intel. Skills — concept								
Intel. Skills — procedr								
Intel. Skills — princpl								
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the following kinds of problems:

Motivation								

Feasibility:
  utility

  flexibility

  cost-effic.

  adaptability

  implemntblty

Other

Figure 1

useful for purposes of prescribing instructional strategies. Hence, the intellectual Skills category has been subdivided into (a) concept classification, (b) procedure using, and (c) principle using. Each of the remaining domains is incorporated as a general category with no subcategories.

Strategy Functions

After learning outcomes, we felt that the next most useful basis for classifying strategies would be the function of each strategy. We believe that the most useful classification of strategy functions is that of Reigeluth and Merrill (1978), which identifies the major strategy functions as (1) organizing the instruction, (2) delivering the instruction, and (3) managing the instruction. These strategy functions formed the second dimension in our classification scheme. This dimension, arranged against the outcome dimension formed our review matrix (see Figure 1).

For purposes of prescribing strategies, it was felt that only organizational strategies need be divided into subcategories. The first major classifications of organizational strategies are micro and macro strategies. Micro strategies are used for teaching individual ideas: facts, concepts, principles, and procedures. Micro strategies may be either primary or secondary. Primary strategy components are the major forms in which knowledge can be represented: concrete form (instances) and abstract form (generalities), and expository form (telling) and inquisitory form (asking). Secondary strategy components suggest what enrichment should be included in the instruction, such as visual representations, attention focusing devices, mnemonics, cues, and example divergence.

Macro strategies deal with groups of skills and knowledges selected for a course. They include strategies for (a) selecting, (b) sequencing, (c)

synthesizing, and (d) summarizing the course content.

Organization of this Review

Each individual piece of literature reviewed is described in the Appendix of this review. That description includes only the instructional strategies proposed by the author and any bases for deciding when to use each. In many cases, the theorist or researcher did not directly provide strategy prescriptions. In such cases, we usually translated the descriptive statements into prescriptive strategies. However, it was often necessary to omit much of a theorist's work because we could not present it prescriptively.

In contrast to the Appendix, which is organized by author, the body of this review follows the organizational scheme one box at a time. Given that the purpose of this review was to provide a knowledge base for creating the best possible instructional strategy prescriptions, it was decided to organize this review so that it breifly summarizes and more importantly compares and contrasts different theorists' and researchers' views on each category of the organization scheme. The body of this review is not intended to provide a thorough description of each strategy but to offer a functional description, commentary, and comparison of them.

As you read through the body of the review, you may find it helpful to refer to the Appendix, especially to read the full statement of the strategies being compared for a specific category.

ORGANIZATIONAL STRATEGIES

Micro Strategies

Verbal Information is a type of learned capability where the learner remembers information. This corresponds to Merrill's remember task level and can be demonstrated either in verbatim or paraphrased fashion.

For learning verbal information, some authors prescribe general principles to be employed. Merrill looks more specifically at the primary presentation forms. He notes that these are the most essential components of instruction to be present in teaching at the remember level. For learners to remember a generality verbatim, the generality should be presented both expositorily (presentation) and inquisitorily (drill). On the other hand, to remember a generality in paraphrased form, those same components should be supplemented by a prototypical example, and the generality should be presented in more than one form. If an instance is to be remembered verbatim, then the instance should be presented both expositorily (example) and inquisitorily (drill). For paraphrased remembering, it should also be presented in more than one form. For remembering a fact, the strategies are the same as for remembering an instance.

A strategy component closely related to the primary presentation forms is feedback. Gerlach has done much work on this strategy. He advocates telling the student the correct response rather than just indicating that the response is wrong or right. In addition, he suggests providing complete informational feedback for complex behaviors.

Fleming and Levie state, in order for information to be acquired more readily and retained longer, it should be made as meaningful to the learner

as possible. This amounts to a recommendation to teach at the paraphrased level of remembrance rather than at the verbatim level. Rothkopf supports this view and suggests that familiar elements should be used in the instructive stimulus to reduce the cognitive burdens. Higbee includes interaction, vividness, and novelty as other important rules to be followed in verbal learning.

Authors such as Levin address specifically the area of secondary presentation forms. Within this area, it is suggested that the use of the "keyword" method and other mnemonic methods such as the pegword method be used along with the method of loci and the "hook" method as powerful techniques for remembering. In addition, the "self-generated visual imagery strategy" and the use of visual/pictorial mnemonic strategies are mentioned. Similarly, Ortony has prescribed the use of metaphors.

Macro Strategies

Gagne and others have recommended that Verbal Information be sequenced by nesting it with the Intellectual Skills to which they are most closely related.

INTELLECTUAL SKILLS

An intellectual skill is a type of outcome in which a learner is able to apply a generality to new cases. It entails applying a concept, a principle, or a procedure to previously unencountered instances.

ORGANIZATIONAL STRATEGIES

Micro Strategies

With respect to primary presentation forms, Merrill prescribes that the presentation should consist of an expository generality and a set of both

expository (examples) and inquisitory (practice) instances. Practice should consist of a set of new inquisitory instances, and helped feedback should be provided after the practice.

Arnsdorf advocates the use of "specific questions directed to particular students", and Collins and Stevens prescribe the use of an inquiry approach by means of a "Socratic dialogue", primarily for teaching principles. Among other things, this inquiry approach deemphasizes the use of generalities.

Gropper suggests the following routine treatments for all objectives: (1) cues telling "what" and "how", (2) examples or demonstrations, (3) rules regarding performance, and (4) practice of intact criterion behavior. Kulhavy suggests that for maximum learning facilitation, designers and trainers should (1) insure that learners have sufficient entry skills, (2) minimize opportunity for students to obtain feedback prior to responding, and (3) provide feedback as often as possible during the course of the lesson.

Secondary presentation forms (SPFs) are enrichment components that are used to increase the instructional effectiveness of the primary presentation forms. Throughout our literature review, we found, in general, that instructional theorists have prescribed similar strategies in this area.

Two common prescriptions are divergence among examples and an easy-to-difficult sequence of examples and practice items. These strategies are emphasized by Collins and Stevens, Gropper, and Merrill. The use of alternative representation forms is suggested by Merrill and Collins and Stevens. Heinich, Mollenda, Russell and James, Dwyer, and Joseph all prescribe the use of visual representations.

Attention focusing devices, in the form of formatting (i.e., separation and labelling), color, and specific directions to the learner were suggested

by Merrill and Arnsdorf. As a form of attention-focusing, Merrill and
Markle have advocated the use of a non-example presented simultaneously with
a matched" example (one that is as simmilar as possible to it) for concept
classification. The non-example should be selected in such a way that it
ennances the student's ability to discriminate between characteristics which
are relevant and those which are not relevant.

Mnemonics are prescribed by many theorists, even for the application
level. Arnsdorf, Fleming and Levie, Gropper, Higbee, and Merrill give much
importance to this strategy. Fleming & Levie address this principle with an
emphasis on organizing material in a way that facilitates the memory
process. Gropper emphasizes the use of "cues" as mnemonics.

Gropper prescribes some secondary presentation forms: cues, familiar
examples, standards for practice, and shaping principles such as his
recognize-edit-produce sequence for practice items. He also prescribes
remediation activities and occasionally practice of errors.

Macro Strategies

The most prevalent prescriptions in macro organizational strategies are
for selection and sequencing strategies. Between these two strategies,
sequencing appears to be the most common.

With respect to sequencing, presentation of the most simple and
inclusive ideas first and then proceeding to progressively more complex and
differentiated ideas is suggested as a common strategy by many theorists.
Bruner's "spiral curriculum" is a version of this which seems particularly
targeted to organizing the simple-to-complex sequence around principles
within a domain. Ausubel's "subsumptive sequence" (of which advance
organizers are a part) is another version of the simple-to-complex sequence,
although it is organized primarily around concepts and to a lesser extent

principles. P. Merrill, Reigeluth, Resnick, and Scandura have all advocated a "shortest path first" approach to sequencing derived from a path analysis of a branching procedure, and this version of the simple-to-complex sequence is organized around procedural content. Gropper and others have reported the same concern in other contexts. The use of "incrementing" (a step-by-step approach) and "shaping" (sequencing the practice events that can advance the approximation of the terminal behavior) are similar sequencing strategies, although they are frequently advocated for the micro level.

There are a variety of other kinds of sequences. Gagne has advocated a hierarchical, or parts-to-whole strategy for all kinds of intellectual skills. Behaviorists, such as Skinner, have advocated the forward-chaining approach to teaching a long sequence of steps. This sequence entails teaching the first step first, followed by the second step, and so on until all steps have been taught. Gilbert has advocated a backward-chaining approach, which entails teaching the last step first (where the whole procedure has already been performed up to that point) so that the learner can receive the full reinforcement value of completing the procedure. The second-to-last step is taught next, followed by practice in the last two steps, and so on until all the steps have been taught. Landa has proposed a variation on the forward chaining approach which he calls the "snowball" approach. According to Landa, after the second step has been taught, the first two steps are practiced together; after the third step has been taught, all three steps are practiced together; and so forth.

With respect to selection strategies, Gagne's hierarchical task analysis is the most common approach. Also popular is the information processing approach to task analysis. Scandura's rule-based analysis is a case in point: each rule should include all of the steps (operations and

decisions) involved in solving the subset of problems represented by the domain's prototypical problem. Scandura also specifies that each of the operations must be atomic in that, for each student in the target population, the ability (or inability) to correctly use the operation once is indicative of uniform success, or conversely uniform failure. The Reigeluth-Merrill Elaboration Theory has proposed content analysis techniques (in addition to task analysis techniques) for identifying conceptual and theoretical content that should be included in the instruction. Employing a different perspective, Scandura also advocates the identification of higher-order rules which can be taught in place of a number of lower-order rules. All of these approaches have been integrated into the Extended Task Analysis Procedure (ETAP), which was developed by Reigeluth and Merrill for TRADOC.

COGNITIVE STRATEGIES

The next section in our review covers cognitive strategies. These are generic cognitive operations which can be applied to many different content areas.

ORGANIZATIONAL STRATEGIES

Micro Strategies

General rules on teaching cognitive strategies are summarized as follows: specifically within the domain of rule learning, Collins and Stevens state, in order to help students to learn to derive a new rule or theory, teach students what questions to ask. Teach students what form a rule or theory should take and how to evaluate a rule or theory that has been constructed. Get students to formulate general rules relating different factors to values of the dependent variable. To get the student

to consider how the values of the known factors fit with different possible values of the dependent variable, have the student consider alternative predictions which force weighing different alternatives in making any predictions or judgments. Moreover, to provide feedback on the derivations of an incorrect rule, trace the consequences of the misconceptions to some conclusion that the student will agree cannot be correct. Finally, encourage the students not to look to the teacher or the book for the correct answers, but rather to construct their own theories.

Still emphasizing his learner-control interest, Merrill prescribes providing students with directions for the conscious cognitive processing of the information provided. This is a general strategy which can be applied to many different levels of learning.

We turn now to consideration of secondary strategy components for teaching cognitive strategies. Collins and Stevens suggest the following. The teacher should teach students to "debug" incorrect rules or theories. The teacher wants the student to confront incorrect hypotheses during learning, so that they will not fall into the same traps later. Positive and negative examplars ("near hits" and "near misses") should be varied systematically so that the student can see how each factor in turn affects the answer. To stress various interactions between different factors and the dependent variable, differentiation, generalization and the range of variability should be used. To force the student to pay attention to different factors affecting the different variables, one should present counterexamples for insufficient factors, for unnecessary factors, and for irrelevant factors. Feedback on student-generated rules can be provided by generating hypothetical cases.

Higbee and Merrill both prescribe learner-generated strategies in this area. Especially for mature or high ability learners, Higbee recommends

having learners make visual associations or draw pictures and diagrams to improve learning. Merrill states that, to avoid over-dependence on help in mental processing, such help should be gradually eliminated while the directions encourage the student to perform this and other cognitive strategies for him/herself.

Macro Strategies

Macro organizational strategies, more specifically selection, sequencing, synthesis and summary strategies for teaching cognitive strategy outcomes, are prescribed and organized as follows. Gropper's and Merrill's prescriptions are for the selection of "learning to learn" strategies. Gropper's main contribution in this area is his prescription to teach students how to make _associations_ between two sets of information, and how to make _discriminations_ and _generalizations_. Both Gropper and Merrill encourage training students to search for information (in texts, lectures, demonstrations, etc.) relevant to the component skills. These preinstructional strategies provide the necessary guidance to initiate student search for information relevant to those skills. Students should be provided with a mechanism for selecting and sequencing those displays which they feel are required to understand a given objective. In summary, students should be taught appropriate adaptive models of how to learn in order that their own inappropriate or ineffective internal theories do not interfere with learning.

MANAGEMENT STRATEGIES

The following section reviews a group of strategies which are instructional _management_ strategies. Our review did not address these strategies in depth because of the general requirement to delimit the scope of our review. However, the following management strategies were identified and are suggested by various authors reviewed in this study.

o Provide verbal rewards to encourage student participation (Arnsdorf).

o Have the teacher try to pursue several goals simultaneously (Collins & Stevens).

o The teacher should maintain an agenda which allows the students to allocate their time among the various goals efficiently (Collins & Stevens).

o Allow students sufficient time to interact with the visual instruction. (Dwyer).

o To insure greater flexibility in conscious cognitive processing, the learner should be given control over pacing (Merrill).

o For a more integrated group of management strategies on pacing, instructions to the student, feedback, mastery, and motivation, see F. Keller in the Appendix.

APPENDIX

SUMMARY OF INSTRUCTIONAL STRATEGIES

DESCRIBED IN EACH ARTICLE AND BOOK

Contents

Arnsdorf
Ausubel
Collins and Stevens
Dwyer
Fleming and Levie
Gerlach
Gropper
Heinich, Molenda, Russell and James
Higbee
Joseph
Keller
Kulhavy, Yekovich and Dyer
Kulhavy
Levin
Merrill
Ortony
Rogers
Rothkopf
Scandura

Classification of Strategies Prescribed

Functions:		Organizational						Managmt	Delivry
		Micro			Macro				
Outcomes:		PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information									
Intel. Skills	concept		1					4,5	
	procedr	3,7	2 6						
	princpl		8						
Cognitive Strategies									
Affective Domain									
Psychomotor Domain									

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation									

        utility

        flexibility

Feasibility: cost-effic.

        adaptability

        implemntblty

Other

Arnsdorf

1. Give special directions such as "pay close attention" or "don't pay close attention." (p. 431)

2. "Pause after stating something of special importance." (p. 431)

3. Ask specific questions directed to particular students. (p. 431)

4. Have students direct their questions to other students. (p. 431)

5. Give verbal rewards to encourage student participation. (p. 432)

6. Use auditory devices for emphasis such as tapping lightly on the blackboard, using silent handclapping for applauding correct answers, and using choral reading. (p. 432)

7. Use examples that are interesting to the student or supplied by the student.

8. Use color to highlight important concepts.

Author: Ausubel, David P.

Publication:

Classification of Strategies Prescribed

Functions: Outcomes:	Organizational						Managmt	Delivry
	Micro		Macro					
	?	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
Intel. Skills — concept, procedr, princpl			5,9	6,9,10	9,10	8	10	
Cognitive Strategies	7(b)	2	7(a) 7(b) 3	7(b) 3			1,4	
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the following kinds of problems:

Motivation								

  utility

  flexibility

Feasibility: cost-effic.

  adaptability

  implemntblty

Other

Ausubel

1. Give guidance to learners to help them organize new information in meaningful ways. (p. 1).

2. Make content meaningful to the learner through external content organizations and internal development of cognitive structures. This helps integrate the content with already existing structures. (p. 1).

3. Provide in the instructional sequence for the learner to develop independent skills in evaluating and controlling his/her own learning. (p. 1)

4. To achieve "meaningful-reception" learning in Ausubel's terms, present instruction in a meaningful expository fashion.

5. To help make the content meaningful, use non-arbitrary, lucid, and plausible content and materials.

6. To enable meaningful learning and retention of new ideas, make sure that more inclusive and appropriately relevant concepts and propositions are already available within the learner's cognitive structure to subsume the new content and provide ideational anchorage for it. Therefore present more inclusive and general content first.

7. To strengthen existing cognitive structure

   a) substantively, teach the most inclusive and integrative explanatory concepts and propositions that exist within a given discipline as prior learning materials.

   b) programmatically, select optimal methods of presenting, arranging, and ordering learning materials and practice trials. (p. 7)

8. Use advance organizers, which are clear and stable subsumers introduced in advance of the learning material itself. These must be at a high

level of abstraction, generality and inclusiveness, and must be capable
of explaining, integrating, and interrelating the material they precede.

- For completely _unfamiliar_ new content, use _expository_ .
  organizers.

- For _familiar_ new content, use _comparative organizers_.

9. Present the most general and inclusive ideas of the discipline first,
    and then progressively differentiate those ideas in terms of detail and
    specificity.

10. Require consolidation or mastery of ongoing material before introducing
    new material. Strive for overlearning, which requires an adequate
    number of adequately spaced repetitions and reviews, sufficient
    intra-task redundancy prior to intra- and inter-task diversification,
    opportunity for differential practice of task components, and frequent
    testing with feedback. (pp. 8,9)

Author: Collins, A. and Stevens, A.

Classification of Strategies Prescribed

Functions: \ Outcomes:	Organizational Micro PPF	SPF	Organizational Macro Sel	Seq	Syn	Sum	Managmt	Delivry
Verbal Information								
Intel. Skills — concept			4					
Intel. Skills — procedr								
Intel. Skills — princpl	3,5	2,7	.					
Cognitive Strategies	19,20 21	6,12,13 14,15 16,20	23,24 25,26	23,24 25,26			1,11,26	8,9,10 17,18,22
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation	27										

        utility

        flexibility

Feasibility: cost-effic.

        adaptability

        implemntblty

Other

Collins and Stevens

<u>Comments</u>:

1. Given a set of factors and a dependent variable, a <u>rule</u> is any function that relates values of one or more factors to values of the dependent variable. (p. 5)

2. Whether a variable is treated as a dependent or independent variable depends on what the teacher is trying to teach. What functions as a dependent variable is merely what one tries to make predictions about in the real world. (p. 9)

<u>Prescriptions</u>:

1. Have the teacher try to pursue several <u>goals</u> simultaneously. The teacher should maintain an agenda which allows him/her to allocate his/her time among the various goals efficiently. (p. 4)

2. Represent causal dependencies in terms of an and/or graph (derived by student in a dialogue). (p. 4)

3. During the course of the dialogue, which is an instructional component, have the student identify the principal <u>factors</u> which cause the effect. These factors (or independent variables) are linked to the effect through chains with various intermediate factors.

4. Treat any variable not included as a factor in the diagram as <u>irrelevant</u> to the theory. (p. 6)

5. Teach students to <u>derive</u> rules or theories. (p. 13)

6. Teach students to <u>"debug"</u> <u>incorrect</u> <u>rules</u> or theories. Have the students confront incorrect hypotheses during learning, so that they won't fall into the same traps later. (p. 14)

7. Teach students how to make <u>novel predictions</u> based on a rule or theory. This can be done by giving harder and harder problems for the student to predict the answer. (p. 14)

8. In order to help students to learn to <u>derive a new rule</u> or theory, teach students <u>what questions</u> to ask. These could include asking how fair it is or asking taxonomic kinds of questions. (p. 15)

9. Teach students what <u>form</u> a rule or theory should take. (p. 15)

10. Teach students how to <u>evaluate</u> a rule or theory that has been constructed. (p. 15)

11. Have students <u>verbalize and defend</u> their rules or theories. (p. 16)

12. Select positive and negative exemplars ("near hits," and "near misses"). (pp. 17-19)

13. Vary cases systematically so that the student can see how each factor in turn affects the answer. (pp. 20-21)

14. To stress various interactions between different factors and the dependent variable, use differentiation, generalization, and range of variability. (p. 22)

15. To force the student to pay attention to different factors affecting the dependent variables, present counterexamples for insufficient factors, for unnecessary factors, for irrelevant factors, and for incorrect values of factors. (pp. 22-25)

16. Provide feedback on student-generated rules by generating hypothetical cases. (p. 25)

17. Get students to formulate <u>general rules</u> relating different factors to values of the dependent variable. (p. 28)

18. Teach the student to evaluate hypotheses by holding other variables constant when testing out a hypothesis. (p. 32)

19. To get the student to consider how the values of the known factors fit

with different possible values of the dependent variable, have the
student consider alternative predictions which force him or her to weigh
different alternatives in making any predictions or judgments. (pp.
35-37)

20. To get the students to reveal their underlying misconceptions, use
    entrapment strategies. This is done by taking the student's reasons and
    turning them into a general rule. (p. 38)

21. To provide feedback on the derivation of an incorrect rule, trace the
    consequences of the misconception to some conclusion that the student
    will agree cannot be correct. (p. 41)

22. Encourage the students not to look to the teacher or the book for the
    correct answers, but rather to construct their own theories. (p. 45)

23. Select cases that illustrate more important factors before less
    important factors. (p. 47)

24. Select cases to move from concrete to abstract factors. (p. 47)

25. Select more important or more frequent cases before less important or
    less frequent cases. (p. 48)

26. When a case is selected, have the teacher begin by questioning students
    about the values of the dependent and independent variables, and the
    rules interrelating them. The answers reveal what the student does and
    does not know with respect to the teacher's theory, and this should be
    selected as the content for the instruction. (p. 49)

27. To build up motivation, have students become involved in the process of
    creating new theories or recreating theories that have been developed
    over centuries. By turning learning into problem-solving, students
    become more motivated. (p. 51)

Classification of Strategies Prescribed

Functions: Outcomes:	Organizational						Managmt	Delivry
	Micro		Macro					
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
Intel. Skills — concept							2	
Intel. Skills — procedr								
Intel. Skills — princpl								
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation									

       utility

       flexibility

Feasibility: cost-effic. 1

       adaptability

       implemntblty

Other

Dwyer

1. If two or more types of visuals are equally effective in increasing
   student achievement, then in terms of time, talent and funds, use the
   least expensive type (i.e. simple line drawing instead of realistic
   model). (p. 23)

2. Allow students sufficient time to interact with the visual instruction.
   (p. 23)

Author: Fleming, M., and Levie, W. M.

Classification of Strategies Prescribed

| Functions: | | Organizational | | | | | | Managmt | Delivry |
| Outcomes: | Micro | | | Macro | | | | | |
	PPF	SPF	Sel	Seq	Syn	Sum			
Verbal Information	2,7 10	25,33 34,35 37,46	1,3 4,5 6,8						
Intel. Skills — concept	30	40 11 43 15 16	9,12 13,14 19,20	26	23,24 28,29	24	29		
Intel. Skills — procedr	32	17 18 39	21 22 27 31 36 38						
Intel. Skills — princpl		41 42	44 45 47,48 49						
Cognitive Strategies	35		33,36						
Affective Domain									
Psychomotor Domain									

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation									

utility

flexibility

Feasibility: cost-effic.

adaptability

implemntblty

Other

Fleming and Levie

1. In order for information to be acquired more readily and retained longer, make it as meaningful to the learner as possible.

2. To facilitate students' learning to associate or relate two or more objects or events (stimuli and/or responses), arrange for those objects or events to occur or be encountered in contiguity, i.e., close together in time and/or space.

3. To improve learning, increase the frequency with which the stimuli are encountered and the same or similar responses are made. Repetition or rehearsal serves well for short-term maintenance of information, but other, deeper processes (recoding, elaboration, transformation) are important for retention over longer periods. The less meaningful the material for the learner, the more repetition that is required.

4. To make learning more efficient and lasting, make the consequences for the learner more pleasant, interesting, tension-reducing, useful, instrumental, rewarding, and/or informative.

5. To facilitate the association of two or more elements, highlight their similarities. Conversely, to facilitate the discrimination of two or more elements, highlight their differences.

6. To facilitate either association or discrimination, reduce the number of elements to be memorized.

7. For a relatively large number of elements to be memorized, employ such factors as order, organization, and other instructional conditions which facilitate memory (modality and sign type, cues and prompts; unit size and organization, learner activity and strategy).

8. In general, employ during instruction the same modality as that used in

the final testing or application situation.

9. To increase learning, employ two modalities simultaneously, e.g., vision and audition or vision and touch rather than only one. However, avoid conflicting information in two modalities, it can interfere with learning. On the other hand, excessive redundancy in two modalities (hearing and seeing the same words) may induce boredom or inattention to one modality. When you use two modalities, include quantitative and qualitative dimensions.

10. To facilitate learning and remembering, make the things to be associated as concrete as possible. More specifically, objects and pictures of objects are better remembered than their names. This prescription holds for a variety of learning conditions including recognition, paired-associate, and free recall. Also, concrete words are better remembered than abstract words.

11. For the new learner begin instruction in a subject area with the more concrete messages and move to the more abstract ones as the learner proceeds to higher levels of the subject. This holds for learners of all ages. A distinction must be made between the concreteness of a message and the concreteness of the concept being presented. They need not be the same. Often the teaching of concrete concepts can benefit by abstraction which reveals the relevant attributes. Also, it is often the teaching of abstract concepts that can profit most from concrete messages; examples, illustrations, analogies, models, diagrams.

12. To most facilitate concreteness, use it at the stimulus side of the association more than the response side. An effective combination of iconic and digital signs appears to be a pictorial stimulus and a verbal response, e.g., label or description. To the extent that a word labels or categorizes a pictured object or event, it can facilitate the coding

process. An effective combination of digital signs usually is a more concrete word as stimulus and a less concrete word as response.

13. To facilitate learning what is relevant or criterial in a situation, increase the degree to which instruction controls the effective stimulus. You can add or subtract cues or make cues more or less salient (prominent, noticeable) to control the effective stimulus (the notion of 'competing background').

14. Avoid adding any more richness than necessary to the message design.

15. Employ maximum cueing (minimum error) with media which do not readily provide corrective feedback, e.g., ITV and film; whereas minimum cueing could (not necessarily should) be employed with media which readily provide corrective feedback, e.g., teacher, branching program PI, and CAI.

16. Add non-criterial cues (all cues other than those that define the concept to be learned) only if and as necessary.

17. Therefore "magnify" or accentuate the criterial features and "reduce" or eliminate the non-criterial features especially when they are "noisy".

18. To facilitate learning, apply maximum cueing to initial learning to assure correct responding. Fade noncriterial cues and salience cues in subsequent instruction.

19. If initial instruction is minimally cued then add cues until learner can respond correctly.

20. Provide the learner with the correct responses as soon as possible after the learner's response.

21. To aid students in their learning, require them to repeat a previously missed item and respond to it correctly.

22. Add cues which are familiar and/or which direct attention to relationships.

23. Provide larger instructional units for mature and/or motivated learners
    and smaller instructional units for immature and/or unmotivated
    learners.

24. First provide a simplified overview and then provide the parts
    one-at-a-time. The parts would be larger than initially employed by
    programmers but smaller than is typical of texts or lectures. Generally
    space or distribute practice throughout the unit of instruction.

25. To improve associative learning, ins   that there is a meaningful
    relationship between things associated.

26. If a new stimulus is similar to previously learned stimuli, then require
    that the new response be similar to those previously made.

27. Insure that the organization of instructional materials is apparent to
    the learner.

28. Place the most important subject matter at the beginning or end of the
    instructional unit.

29. To facilitate the learning of subsequent details, provide an
    introduction to relatively abstract and general material. Provide
    advance organizers and summaries.

30. Insert questions frequently in instructional prose, especially following
    the passage to which they pertain.

31. Use the active form of sentence structure whenever possible.

32. To facilitate learning, allow the learner to react to or interact with
    the criterial stimulus.

33. To facilitate associative learning, help learners develop cognitive
    strategies that allow the generation of a relational mental image.

34. When an association should include more than two items, design or have
    students generate a more complex and exotic image which incorporates the
    several items in interactive and elaborated relationships.

35. Demonstrate the cognitive process (interactive imagery) with objects or pictures for younger learners who cannot perform it themselves.

36. When necessary supplant other cognitive processes with media. For example, films and TV can supplant (serve as substitutes for) the mental process of visualizing (imagining) certain spatial events or relations, such as making a cross-section through the earth. For a learner who has never observed or learned about such processes, supplantation is necessary; for more experienced learners, presentation of just the label might be a sufficient cue for the generation from memory of the appropriate visualization, either as a mental image or as a drawing.

37. Facilitate associative learning by helping learners develop the strategy of generating a relational sentence or paragraph, because words embedded in a sentence or paragraph are more readily associated than those processed in isolation.

38. Take differences in learner strategies into account in the following ways:
    a. Adapt instruction to the preferred strategy of the learner,
    b. Inform the learner of an effective strategy for coping with each unit and train the learner to employ it, or
    c. Incorporate varied instructional approaches in each unit, such that the learner can find some representation of the content which is acceptably consistent with his/her strategies.

39. To facilitate transfer, arrange the learning situation so that it resembles the testing or application situation where learning is practiced in various realistic contexts. Discrimination learning is facilitated by practice and benefits from corrective feedback and reinforcement.

40. To facilitate discrimination learning, make the differences between

stimuli maximal. Maximize differences by exaggerating the criterial features, by increasing the number of feature differences, and by eliminating or reducing the dominance of the non-criterial features.

41. To facilitate learning, provide examples which are most different at the beginning of instruction and proceed to those with finer differences to the extent required.

42. Where the differences are sensible and meaningful compare the items simultaneously; but where the differences are arbitrary, teach the characteristics of one item (e.g., the letter "m") separately until moderate competence is reached, and then introduce the item to be discriminated (e.g., "n") and provide for practice in identifying "m" in the presence of "n".

43. To facilitate concept learning, use the concept name in contiguity with each presented example.

44. Use a pictorial stimulus and a verbal response (e.g. label or description) as an effective combination of iconic and digital signs.

45. To increase the amount of information that can be received and processed at one time, improve the organization or pattern of the message.

46. Do not present more than about seven items if you want them adequately perceived at a glance and held in immediate memory.

47. To improve communication, make the message as familiar as possible.

48. Use simplified examples such as line drawings, cartoons, charts, and diagrams, rather than realistic pictures.

49. To facilitate perception of differences, arrange things side-by-side.

Classification of Strategies Prescribed

Functions: Outcomes:		Organizational						Managmt	Delivry
		Micro			Macro				
		PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information			1,3,4						
Intel. Skills	concept								
	procedr								
	princpl								
Cognitive Strategies									
Affective Domain									
Psychomotor Domain									

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation			5,6							

        utility

        flexibility

Feasibility: cost-effic. 2

        adaptability

        implemntblty

Other

Gerlach

Comments:

1. Task-intrinsic feedback is feedback which occurs as a direct consequence of the response. It happens mostly in psycho-motor tasks (e.g. movement of the stick in flying an airplane). (p. 3)

2. Augmented feedback is a combination of external feedback and task-intrinsic feedback (e.g. buzzer, other auditory or visual feedback).

3. Informational feedback, irrespective of subject's response, indicates correct response and why it is correct.

4. Feedback variables include:

    a. Amount of information in feedback stimulus,

    b. Frequence of feedback,

    c. Immediacy of feedback, and

    d. Interaction between feedback and incentives for acceptable performance.

5. Low-ability students benefit most from feedback. (p. 9)

6. Studies show frequency of feedback produces no significant effect on posttest achievement.

7. Variations in immediacy of feedback in instructional materials haven't commonly resulted in differences in posttest achievement.

Prescriptions:

1. Tell students the correct response rather than just indicating that the response is wrong or right. (pp. 7-8)

2. Provide complete informational feedback (including explanation of why

correct) for complex practice items.

3. To increase learning by having learners spend more time on the task, do not provide feedback for every practice item.

4. To facilitate retention, delayed feedback may be helpful. (p. 16)

5. Provide positive reinforcement to facilitate performance. (p. 18)

6. To facilitate achievement, allow students to devise their own rewards for correct answers.

Author: Gropper, G. L.

Classification of Strategies Prescribed

Functions: Outcomes:		Organizational						Managmt	Delivry
		Micro			Macro				
		PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information			2 4						
Intel. Skills	concept	2 1 11	23 9 20 6 8			3			
	procedr	7 29	16 21 12 17 22 13 18 24 14	19	25 28				
	princpl		26 15 27 29						
Cognitive Strategies				10					
Affective Domain									
Psychomotor Domain									

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation										

        utility

        flexibility

Feasibility: cost-effic.

        adaptability

        implemntblty

Other

Gropper

Comments:

1. The taxonomy adopted in the model under discussion focuses on skills and
   conditions of performance -- not on types of objectives.

   Component skills: discrimination, generalization, association,
   chaining

   Conditions of performance: recall and transfer (p. 15)

   A post-instructional "recall requirement" affects only what has been
   previously encountered during instruction. A post-instructional
   "transfer requirement" identifies previously non-encountered situations.
   (pp. B-2,3)

2. Strategy formulation builds on an identification of the level of
   difficulty students can be expected to experience in learning new
   skills. (p. B-4)

3. - The greater the similarity among stimuli that belong to different
   classes, the more difficult it will be to discriminate among them. (p.
   B-6)

   - The greater the similarity among stimuli that belong to the same
   class, the easier it will be to generalize from one instance to another.
   (p. B-6)

4. Preparatory progressions are strategy components for teaching an
   individual objective (p. C-1)

5. Contingent progressions are strategy components for teaching multiple
   objectives.

Prescriptions:

1. "Whatever the nature of the stimulus, the response or the reinforcement, establishing stable, stimulus control depends on the same two learning conditions: _practice_ of an appropriate response in the presence of a stimulus that is to control it and delivery of _reinforcement_ following its practice." (p. A-4) So provide for enough practice of an appropriate response and present reinforcement after each practice unit.

2. To teach discrimination of stimuli, provide differential reinforcement.

3. _Incrementing_: Learning all the S-R units in a complex behavior may require an "incremental" or step-by-step approach. Each S-R unit may have to be learned by itself or in groups of two or more and then be added onto and integrated with other previously learned S-R units in a chain. (p. A-11)

4. _Shaping_: Sequence the practice events that can advance the approximation of the terminal behavior until finally students are able to perform at a criterion level. (p. A-12)

5. _Fading_: Students are gradually weaned from the help that cues provide. (p. 12)

6. If a post-instructional recall requirement exists, then the stimulus that will exist following the completion of instruction should be used as an appropriate occasion for making a response during instruction. (p. B-2)

7. To measure if learning is being transferred, use non-encountered situations in the test.

8. Because of their capacity to elicit the practice of appropriate responses, model demonstrations, pictures, words, symbols, etc. can all serve as "cues" (p. B-11). Stimulus control should be gradually transferred from any of these types of cues to the criterion stimulus, so that, even in the absence of a cue, the criterion stimulus is capable

of eliciting the desired response. The criterion stimulus has then achieved stimulus control.

9. To facilitate discrimination, divergent examples should be presented. (p. B-16)

10. "Learning to learn": Train students to search for information (in texts, lectures, demonstrations, etc.) relevant to the component skills. Students could be given statements of objectives and a description of their component skills. These preinstructional strategies would provide the necessary guidance to initiate student search for information relevant to those skills. (p. B-27)

11. To teach "recall of facts", teach associations between two sets of information.

   To teach "rule following", teach chains of S-R units.
   To teach "problem-solving", teach chains and discriminations and generalizations. (p. C-3)

12. Use cues such as lectures, demonstrations, job aids, definitions, gimmicks, and a single word or symbol to provide guidance to any type of performance. (p. C-6)

13. Early in the learning process, when students are most in need of help, use strong cues. As mastery gradually increases and therefore as learner needs for cues diminish, gradually diminish cue strength. Finally eliminate cues when students are judged capable of responding to a criterion stimulus alone. (p. C-6)

14. In the early stages of practice, provide maximum help through the use of familiar examples (e.g., animals or objects) or through the use of other highly familiar visual, symbolic, or verbal cues (e.g., colors or diagrams). (p. C-8)

15. Select the number of practice stages on the basis of anticipated

learning problems and the amount of help judged to be necessary for dealing with them. (p. C-9)

16. Use _model_ _demonstration_ as a cue in _practice_ for teaching _procedures_. (p. C-9)

17. To increase the effectiveness of a model demonstration, make it more similar to the behavior to be practiced. (p. C-10)

18. Amount of behavior practiced: Use a _progression_ of practice tasks by starting with small units, continuing with "n" units of intermediate size, and ending with the largest unit, the entire criterion behavior. (p. C-14)

19. If you have difficult procedural decisions or if you have many procedural steps, try to break up the criterion behavior into small units. (p. C-15)

20. _Elaboration_: In early practice stages, attributes of a criterion behavior can be either removed or diminished, gradually re-introduced as practice progresses, and included in their entirety during criterion practice. (p. C-16)

21. Start with lesser standards in the beginning of practice. (p. C-16)

22. To implement shaping, you can simplify the response mode in early practice. Use a Recognize > Edit > Produce progression in response mode. (p. C-20)

23. Use matched non-examples in recognition practice. (p. C-20)

24. Always precede an _abstract_ and potentially difficult mode (the criterion mode) with more _concrete_ and, hence, easier modes. (p. C-21)

25. To teach principles _(about_ procedures), present prior practice of the procedures themselves as a concrete introduction. (p. C-24)

26. To create "easy" practice items, use cases that are high in familiarity, similarity, and saliency.

27. Promote practice of errors for: teaching behaviors that are known to be error prone, remediation for behaviors that are currently being performed incorrectly, and teaching behaviors that routinely require a performer to monitor and correct his or her own performance. Also, with criterion behaviors that involve motor skills, show "right" and "wrong" ways of doing the task.

28. Procedural tasks or problem solving activities made up of long chains of steps should be learned in a reverse order. (p. C-30)

29. For _all_ objectives, use the following routine treatments:

   - cues telling "what" and "how"

   - examples or demonstrations

   - rules regarding performance provided

   - practice of intact criterion behavior. (pp. D-4,5)

Classification of Strategies Prescribed

Functions: Outcomes:	Organizational						Managmt	Delivry
	Micro		Macro					
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
Intel. Skills — concept		1 2						
Intel. Skills — procedr		3 4						
Intel. Skills — princpl		5 6						
Cognitive Strategies		7 8						
Affective Domain		9						
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation											

          utility

          flexibility

Feasibility: cost-effic.

          adaptability

          implemntblty

Other

Heinich, Molenda, Russell

1. To increase the effectiveness of the instruction, make visuals as iconic, or pictorial (that is, as close as possible to representing the thing or concept being referred to) as possible. (p. 63) But for young learners, or for mature learners with minimal entering knowledge, do not make the visual too realistic, otherwise the learner may be distracted by irrelevant details. (p. 64)

2. Place the most important element of the visual in the upper left corner. If the required message must, by the nature of the context, be in the lower right, the eye of the observer should be led there by use of color, composition, or texture. (p. 71)

3. Keep distractions out of the frame of the image.

4. To retain attention on the visual, change the image, such as from motion, to static, to motion.

5. Arrange the visual in such a way as to direct attention to relevant details.

6. Make visuals harmonious, by fitting the images together in an eliptical or U-shape.

7. Avoid imbalance in the visual. (p. 76)

8. a. Use color to heighten realism (fidelity)

   b. Use color to highlight (emphasis). Use red, orange.

   c. Use color to create emotional response. Use brown for masculine, gold, silver, black for prestige, blue for sweet and orange for edible. (p. 77)

   d. Reduce the business of visuals by using analogous colors. (p. 78)

9. In the cognitive domain, emphasize clarity and accuracy in your visuals;

provide clear visuals for concepts. (p. 79) In the affective domain, emphasize attractiveness and credibility. Novelty, complexity and exaggeration may contribute to gaining attention and making an impact. (p. 79)

10. In the psychomotor domain; (a) emphasize clarity and highlight relevant details, (b) motion may be required, (c) provide for practice of the skill. This requires that a display be located in a place where practice can occur -- e.g. near an object used in the practice or close to the practice field.

Classification of Strategies Prescribed

Functions:	Organizational Micro		Organizational Macro				Managmt	Delivry
Outcomes:	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
concept		1 2						
Intel. Skills procedr		3						
princpl								
Cognitive Strategies		4						
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation									

          utility

          flexibility

Feasibility: cost-effic.

          adaptability

          implemntblty

Other

Higbee

<u>Comments</u>:

1. This article deals with <u>visual</u> <u>mnemonic</u> techniques and the use of both mental images and actual pictures is implied.

2. Evidence is mixed as to whether or not <u>self-generated</u> or <u>supplied</u> imagery is more effective. Some studies have found that self-generated imagery is not as effective for young adults, children and the mentally retarded, while other studies show self-generated images to be more effective for them.

3. The feasibility of using mnemonic training is supported by evidence that it aids in learning sentences, vocabulary, prose material, concepts, and foreign languages as well as paired-associate learning of concrete word lists. "There is even evidence that imagery can help in understanding verbal material as well as remembering it." (p. 622)

4. "The mnemonic has several advantages as a teaching tool. The imagery mnemonic does not require literacy among the learners. The mnemonic is easy to learn and difficult to forget. It is useful with large numbers of people, and it is <u>cost</u> <u>effective</u> because images are inexpensive to construct, easy to transport, and impossible to consume. They also never wear out, and they never rust or need paint."

<u>Prescriptions</u>:

1. <u>Interaction</u> - If you are picturing two items to be associated, they should be interacting (i.e., to associate "dog" and "broom", have the dog sweep with the broom rather than stand next to the broom). (p. 617)

2. <u>Vividness</u> - The picture should be "clear, distinct, and strong." Make

the picture more detailed. For a dog sweeping with a broom - "picture a dachshund sweeping mud off your porch with a push broom; or a bulldog sweeping food off the kitchen floor with a straw broom." Vividness of imagery suggests better retention. (p. 617)

3. <u>Novelty</u> - Novel visual associations between objects may help memory more than common associations, but they need not be bizarre. (p. 618) (i.e. A man playing a harp vs. a harp playing a man.) (An airplane parked near a tree vs. airplanes growing on trees.)

4. Have learners make visual associations, or draw pictures and diagrams (p. 624). But, self-generated imagery may be more effective for mature or high ability learners. (p. 619)

Classification of Strategies Prescribed

| Functions: | | Organizational | | | | | | | Managmt | Delivry |
| Outcomes: | | Micro | | | Macro | | | | | |
		PPF	SPF	Sel	Seq	Syn	Sum			
Verbal Information										
Intel. Skills	concept									
	procedr									
	princpl									
Cognitive Strategies			1,2							
Affective Domain										
Psychomotor Domain										

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation											

Feasibility: utility

               flexibility

               cost-effic.

               adaptability

               implemntblty

Other

Comments:

1. This article discusses memory aids. In general, they include any techniques or systems which help improve memory. At a more specific level it discusses rather unusual, artificial memory aids such as narrative stories, acronyms, rhymes, visual imagery, and verbal mediators.

2. Mnemonics can save time to free up for more important tasks. (p. 8)

3. Once a mnemonic system is learned, it can be used over and over. Once mastered, it will be worth the time.

Prescriptions:

1. Use mnemonic systems. They are more versatile memory aids which can be used over and over to learn new sets of materials (existing research has focused on three). Examples are:

   a. Loci system -- items to be remembered are associated with prememorized locations (loci).

   b. Peg-word system - items to be remembered are associated with pre-memorized pegwords that rhyme with the numbers one to ten (one-bun, two-shoe, etc.).

   c. Phonetic system - consonant sounds are paired with the digits 0 to 9, and are then used to construct pegwords as in the peg-word system.

2. To increase learning, have learners create their own images.

Author: Joseph, J. H.

Classification of Strategies Prescribed

Functions:		Organizational						Managmt	Delivry
		Micro			Macro				
Outcomes:		PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information									
Intel. Skills	concept		1						
	procedr		2						
	princpl								
Cognitive Strategies									
Affective Domain									
Psychomotor Domain									

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation									

        utility

        flexibility

Feasibility: cost-effic.

        adaptability

        implemntblty

Other

Joseph

1. a. For learners with high entering knowledge of the subject, provide
   realistic, detailed visuals.

   b. For learners with medium entering knowledge of the subject matter,
   provide both realistic visuals and more simple abstract
   representations (i.e., line drawings) simultaneously.

   c. For low entering knowledge students, use either realistic or abstract
   visuals.

2. To aid in retention, supply learners with visuals which integrate
   abstract and realistic visualizations (e.g., a line drawing superimposed
   on a realistic photo).

Author: Keller, Fred S.

Publication: Good-bye Teacher---, Journal of Applied Behavior Analysis, 1968, 1, 79-80.

Classification of Strategies Prescribed

Functions: Outcomes:	Organizational Micro PPF	SPF	Macro Sel	Seq	Syn	Sum	Managmt	Delivry
Verbal Information								
Intel. Skills — concept							1,2,3,4 5,7,8,9 10,11	
Intel. Skills — procedr								
Intel. Skills — princpl								
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the following kinds of problems:

Motivation								6,11	

utility

flexibility

Feasibility: cost-effic.

adaptability ⎫
              ⎬ The Keller plan should be extremely adaptable and
implemntblty ⎭ implementable in a military context because of the availability a large enlisted population to choose proctors from.

Other

Keller

1. Allow students to progress at their own rate, but make them aware that,
   to get a final grade of "A, they should complete a certain amount of
   work per week. (pp. 80,82)

2. Clearly present educational objectives and review them often.

3. Frequently assess student progress toward objectives.

4. Allow students to go ahead to new material only after they demonstrate
   mastery of preceding content. (p 81)

5. Allow students to take exams as many times as necessary to show mastery.

   6. Proctors should immediately correct exams and give appropriate
      feedback to students. (p. 82)

7. Give students an opportunity to justify their questionable answers. (p.
   82)

8. If the student misses only 1 to 3 questions, the proctor should direct
   him/her to specific remedial work. If the student misses 4 or more
   questions, the proctor should direct him/her to repeat the whole unit.
   (p. 82)

9. The proctor should tutor students when necessary. (p. 82)

10. Administer positive reinforcement on a systematic basis, to stimulate
    and maintain favorable progress. (p. 82)

11. Use lectures and demonstrations to motivate rather than to present
    critical material.

12. Use as proctors students who have recently completed the course

Classification of Strategies Prescribed

Functions: Outcomes:		Organizational Micro		Organizational Macro				Managmt	Delivry
		PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information									
Intel. Skills	concept							1	
	procedr		1						
	princpl								
Cognitive Strategies									
Affective Domain									
Psychomotor Domain									

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation											

              utility

              flexibility

Feasibility: cost-effic.

              adaptability

              implemntblty

_____

Other

Kulhavy

Comments:

1. A review of the literature provided no decisive evidence that increases in feedback complexity yield parallel increases in learning or that feedback necessarily functions as reinforcement. (p. 6)

2. High feedback availability negates its facilitation effect, since students merely copy answers and learn little. (p. 6)

3. If feedback availability is controlled and the learner is familiar with subject matter, feedback serves (a) to let the student know when he is right or (b) to correct him (or let him correct himself) if he is wrong. (p. 6)

4. Feedback is most effective when student response confidence is high, whether or not his initial response is correct. (p. 6)
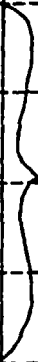

Prescriptions:

1. For maximum learning facilitation:

   a. Insure that learners have sufficient entry skills.

   b. Minimize opportunity for students to obtain feedback prior to responding.

   c. Provide feedback as often as possible during the course of the lesson.

Classification of Strategies Prescribed

Functions: / Outcomes:	Organizational Micro PPF	SPF	Sel	Seq	Syn	Sum	Managmt	Delivry
Verbal Information								
Intel. Skills — concept		1 2					5	
Intel. Skills — procedr		3 4						
Intel. Skills — princpl								
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation									

          utility

          flexibility

Feasibility: cost-effic.

          adaptability

          implemntblty

Other

Kulhavy

Comments:

This is an extensive review of the literature on feedback.

Prescriptions

1. To increase retention on a later test, tell students whether or not each practice answer is correct. (p. 211)

2. To increase retention, provide feedback only after, not before, the student responds. (p. 229)

3. Feedback should confirm correct responses and identify and correct errors - or allow the learner to correct them. (p. 229)

4. Provide feedback as often as possible during the lesson. (p. 229)

5. Make sure learners have appropriate entry skills for the lesson, so that they will spend less time guessing and more time trying to associate feedback with the question. (p. 229)

Classification of Strategies Prescribed

Functions: Outcomes:	Organizational Micro		Macro				Managmt	Delivry
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
Intel. Skills — concept								
Intel. Skills — procedr		} 1						
Intel. Skills — princpl								
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation									

Feasibility:

        utility

        flexibility

        cost-effic.

        adaptability

        implemntblty

Other

Kulhavy, Yekovich & Dyer

Comments:

1. When the confidence for correct response is high, correct responses yield only brief attention to feedback, but high confidence responses which are wrong yield prolonged study of feedback. (p. 97)

Prescriptions:

1. The text material should be absent during responding in order to increase frame study time and reduce errors.

Author: Levin, J. R.

Publication: Pictures for School Learning: Practical Illustrations. Report
               from the Project on Studies in Language: Reading and Communication.
               Wisconsin Research and Development Center, University of Wisconsin,
               October 1980.

Classification of Strategies Prescribed

Functions: Outcomes:		Organizational Micro PPF	Organizational Micro SPF	Organizational Macro Sel	Organizational Macro Seq	Organizational Macro Syn	Organizational Macro Sum	Managmt	Delivry
Verbal Information			1,2,3						
Intel. Skills	concept		}						
	procedr		4						
	princpl		}						
Cognitive Strategies			1						
Affective Domain									
Psychomotor Domain									

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation												

              utility

              flexibility

Feasibility: cost-effic.

              adaptability

              implemntblty

Other

Levin

Comments:

1. "Pictures should not be interpreted in the narrow sense of 'visual illustrations' on the page; rather, they are more broadly defined here to include 'visual imagery' in the head." (p. 4)

2. Pictures serve three functions: representation, organization, and transformation. (pp. 17-18)

Pr_scriptions:

1. Ask learners to use a "self-generated visual imagery strategy which stresses organization of the passage content." (p. 5)

2. In vocabulary learning, pictures should "concretize" the definitions, (representation function) or integrate the vocabulary words with their definitions. The latter process can be accomplished either at a literal level using the vocabulary words as given (organizational function), or in terms of more meaningful recoded stimuli which change the nominal content in some way (transformation function, e.g. "surplus" becomes pictorially related to "syrup"). (pp. 17-18)

3. Combine pictorial mnemonic strategies with other strategies: i.e. question asking, underlining, summarizing. This is because the other strategies seem to be "suitable for retaining theme/main idea information, whereas mnemonic strategies are uniquely suited to coding and retrieving factual information contained in the text." (p. 30)

4. To illustrate concepts, use verbal and pictorial analogies. (p. 29)

Classification of Strategies Prescribed

Functions: Outcomes:	Organizational Micro PPF	SPF	Macro Sel	Seq	Syn	Sum	Managmt	Delivry
Verbal Information		1,2						
Intel. Skills — concept								
Intel. Skills — procedr								
Intel. Skills — princpl								
Cognitive Strategies		2						
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the following kinds of problems:

Motivation								

     utility

     flexibility

Feasibility: cost-effic.

     adaptability

     implemntblty

Other

Levin

Comments:

1. The mnemonic strategies described here are adapted from R.C. Atkinson's keyword methods for learning foreign language vocabulary.

2. Mnemonics can be adapted to other areas of school content (i.e. prose passages) and are effective in conjunction with other strategies such as organizing, questioning, and summarizing. (p. 78)

3. Mnemonics are time-efficient. Impressive learning gains have been shown with little instruction time with transfer to other domains. Transfer in areas of creativity and logical thinking is theorized. (pp. 78-80)

Prescriptions:

1. For memorizing verbal information, such as vocabulary words, use the "keyword" method. To use this method, first link the new information with a previously known, acoustically similar word, then link the acoustically similar word to the meaning of the new word by imagery (e.g., to learn "persuade", connect it with the sound of "purse", then present visual imagery of someone being persuaded to buy a purse.)

2. The pegword method, method of loci, the "hook" method, and verbal analogies could be utilized, rather than pictorial techniques. Such choices should be made on the basis of student differences. (p. 80)

Author: Merrill, D. M.

Publication: What is Learner Control? A Final Report on a NSF grant.

Classification of Strategies Prescribed

functions: Outcomes:	Organizational						Managmt	Delivry
	Micro		Macro					
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information		2						
Intel. Skills — concept	2 3	3 5	1	1			1,9	
Intel. Skills — procedr	4	6 7						
Intel. Skills — princpl		8						
Cognitive Strategies			10					
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the following kinds of problems:

Motivation										

> utility
>
> flexibility

Feasibility: cost-effic.

> adaptability
>
> implemntblty

Other

Merrill

1. Allow students to have control over selection, sequencing and/or ommission of objectives and displays.

2. Students should be provided with a mechanism for selecting and sequencing those displays which s/he, feels are required to understand a given objective.

3. Displays should be identified, indexed, and isolated in such a way as to facilitate selection of specific displays.

4. Include generalities, examples, generality practice and example practice as kinds of "primary presentation" displays.

5. Provide "secondary presentation" displays in the form of "generality help" when appropriate to further define a generality and/or represent the generality in another form.

6. Provide secondary presentation displys in the form of "example help" by using attention focusing devices when it is helpful to illustrate how the instance is related to the generality.

7. Provide secondary presentation displays in the form of practice help by using attention focusing devices when it is helpful to show students how the problem was solved.

8. Provide students with directions for the conscious cognitive processing of the information presented.

9. To insure greater flexibility in conscious cognition, the learner should be given control over pacing.

10. Teach students appropriate adaptive models of how to learn in order that their own inappropriate or ineffective internal theories do not interfere with learning.

Classification of Strategies Prescribed

Functions:		Organizational						Managmt	Delivry
Outcomes:	Micro			Macro					
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information	4,5 6,7	10,15 1 16,17 8 33 9						
Intel. Skills — concept		19 32 20 11 35 21 36					9	
Intel. Skills — procedr	2	12 37 13 38 39						
Intel. Skills — princpl		14 40 41						
Cognitive Strategies	3,13	22,23 24,34	39					
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation										

utility

flexibility

Feasibility: cost-effic.

adaptability

implemntblty

Other Testing: 25,26,27,28,29,30,31

Merrill

Comments:

1. All cognitive subject matter can be presented at

    - a general level, as generalities, and/or

    - a particular level, as instances. (p. 28)

2. An expository generality entails merely telling, illustrating or showing the generality to the student. (p. 28)

3. An inquisitory generality requires the student to respond by recognizing the generality or recalling it from memory. (p. 28)

4. A given micro strategy, as specified by CDT (Component Display Theory), can be used with a wide variety of subject matters and content organizational schemes, with virtually any delivery system, and with a wide variety of different techniques for managing the instruction. (p. 4)

Prescriptions:

1. To facilitate students' processing of information or to provide items of interest, such as contextual background, use secondary presentation forms. (p. 30)   For example, you could elaborate an expository instance by providing context, adding information of interest, or adding aides. Oftentimes a given instance consists of a story or a vignette which has far more detail than is necessary for the generality being taught. This secondary information is a form of elaboration which may increase interest or may make the example more meaningful to the student. (p. 31) On the other hand, you could facilitate student's understanding or ability to solve a problem by modifying the format of the problem.

Present the same instance using more than one form of <u>representation</u>.

2. At the <u>use level</u>, the presentation should consist of an expository generality (EG) and a set of instances, both expository (examples) and inquisitory (practice). Practice should consist of a set of new inquisitory instances. Use helped feedback. (p. 37)

3. At the <u>find level</u>, there is no presentation. Practice should consist of a set of new inquisitory instances, and an inquisitory generality. Feedback should be generated by the student as follows:
   In a concept situation, the definition invented by the student should be presented to another student to see if this other student can use the definition to classify instances. If s/he can, this is feedback as to the adequacy of the concept which was invented. (p. 47)

4. At the <u>remember-a-generality paraphrase</u> level, the presentation should consist of an expository generality and an expository instance. Practice should consist of an inquisitory generality in paraphrased form. Use correct answer feedback. (p. 47)

5. At the <u>remember-a-generality verbatim</u> level, only an expository generality should be presented. Practice is an inquisitory generality. Use correct answer and attention focusing feedback.

6. At the <u>remember-an-instance paraphrased</u> level, the presentation should be an expository example. Practice is inquisitory instances (the same instance) presented in different representations. Use correct answer feedback. (p. 47)

7. At the <u>remember-an-instance verbatim</u> level, the presentation should be an expository example. Practice is inquiring about the same example. Use correct answer and attention focusing feedback.

8. Feedback should always accompany practice at every performance level, both for correct and incorrect responses. (p. 47)

9. Delay feedback until student has checked adequacy of the response (in some cases). (p. 48)

10. At the _remember_ level, use mnemonic elaboration. (p. 48) The student should be presented some mnemonic device to facilitate the student's ability to recall the generality.

11. At the _use_ level, it is suggested that the generality be accompanied by:

    a. _attention-focusing devices_, (or "help" elaboration) which focus the student's attention on critical aspects of the generality and how they relate to instances. This can take the form of exploded drawings, arrows, color, diagrams, etc.

    b. _prerequisite elaboration_, which includes information about prerequisite concepts and facts which are required to understand the definition, the procedure, or the principle which is being presented. This form of elaboration includes definitions or instances of these prerequisite component concepts.

    c. _Alternative representation_. (p. 48)

12. At the _use_ level, it is suggested that each of the expository instances be accompanied by helping or attention focusing information which indicates why this particular instance is an illustration of the generality. This information should also focus the student's attention on the critical aspects of that instance. On the other hand, this type of prompting should not accompany the practice items in a use level presentation. (p. 51) There are variations on this rule as to the amount of secondary helping presentations which might be desirable.

13. To avoid over dependence on help in mental processing, such external help should be gradually eliminated, while directions encourage the student to internally control this mental processing. (p. 50)

14. To increase the student's ability to generalize to new representations,

provide real-world situations in examples.

15. For remembering a fact, design the practice such that the expected behavior will be _recalling_ by writing, drawing, pointing, circling, etc.

16. For remembering a concept, design the practice so that the expected behavior will be _stating_ a _definition_ by either writing, selecting, circling, checking.

17. For remembering a procedure, design instruction so that the expected behavior will be _stating_ _steps_ by drawing, flow charting, listing, or ordering.

18. For remembering a principle, design instruction such that the expected behavior will be stating causal relationships by writing or drawing a formula, graph, etc.

19. For using a concept, design instruction so that the expected behavior will be classifying by writing, selecting, pointing, or sorting.

20. For using a procedure, design instruction so that the expected behavior will be demonstrating by manipulating, calculating, measuring or removing.

21. For using a principle, design instruction so that the expected behavior will be explaining or predicting by writing, calculating, drawing or graphing.

22. For finding a procedure, design instruction so that the expected behavior will be deriving steps by experimenting, analysis, or trial and error.

23. For finding a concept, design instruction so that the expected behavior will be inventing categories by sorting and observing attributes, or specifying attributes.

24. For finding a principle, design instruction such that the expected behavior will be discovering a causal relationship by experimenting,

analysis, observation or demonstration.

25. In testing, _don't_ allow for any delay for remembering a fact or recall of specific instances of a concept or the recall of a fixed procedure. (p. 14)

26. For the remember-definition, -procedure, or -principle level where the student is required to paraphrase or to recognize a paraphrased statement, allow _short delay_ on the test, since searching memory for a paraphrased response does reuire some processing time. (p. 14)

27. For the use-concept level, allow a _short delay_ on the test to allow time to study the instance and classify it. (p. 14)

28. For the use-procedure and use-principle levels, the test performance should be _untimed_ unless a timed response is required by the specific nature of the procedure. (p. 14)

29. The _find_ level requires considerabe thinking and study and therefore should be tested by power (untimed) tests. (p. 14)

30. Provide feedback after the entire test is completed. (p. 14)

31. All _prompting_, such as deliberate hints, attention focusing, or other information, should be eliminated during the testing phase of the instruction. (p. 14)

32. Do not include _help_ in the form of prompting in practice at remember-paraphrase and use levels. However, help (prompting) can be provided for some early practice items if content being taught is complex. (p. 51)

33. At the remember level, feedback should be used as the secondary presentation that indicates to the student a correct response.

34. At the find level feedback consists of the success of the student's attempts to demonstrate the generality.

35. Clearly _separate_ and _identify_ primary presentation forms and components

of them by means of some type of graphic or auditory convention. (p. 52)

36. At the use level, make the examples, practice items, and test items consistent with each other. This can be done by drawing them from a single set of instances. (p. 52)

37. The instances for a particular generality should be divergent, i.e., the variable characteristics of these instances should be as different as possible. (p. 52)

38. During the expository presentation, examples should be matched with nonexamples, i.e., the nonexample should be selected in such a way that it enhances the student's ability to discriminate between characteristics which are relevant and those which are not relevant. (p. 53)

39. External matching should be eliminated as the instruction progresses, and the student should be directed to perform the compare-and-contrast operation with instances previously stored in memory. (p. 54)

40. To have an effective presentation, include a sample of instances representing a range of difficulty. (p. 55)

41. Apply the same rules of divergence and difficulty to inquisitory presentations. Do not include the matching rule in inquisitory mode. In most cases present inquisitory instances in random order so as to avoid the potential presentation of matched examples and nonexamples. (p. 55,56)

Classification of Strategies Prescribed

Functions: Outcomes:	Organizational						Managmt	Delivry
	Micro		Macro					
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
Intel. Skills — concept		1 2						
Intel. Skills — procedr		3 4						
Intel. Skills — princpl		5						
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the following kinds of problems:

Motivation									

utility   3

flexibility

Feasibility: cost-effic.

adaptability

implemntblty

Other

Comments:

1. "Topic" is defined as the term to be learned.

2. "Vehicle" is defined as the term used metaphorically to form the basis of comparison.

3. "Ground" is defined as that which the topic and vehicle have in common.

Prescriptions:

1. "Tension", or dissimilarity between the topic and vehicle, should be minimized so the learner will recognize the intended comparison.

2. Compactness thesis: metaphors should be quick and concise. (p. 48)

3. Metaphors should allow "large chunks (of details) to be converted or transferred," to enable comprehension without the message having explicitly to spell out all the details. (p. 47)

4. Vividness thesis: "metaphors should be particularly vivid." They should move through richness of detail from the known to the unknown. "Imaginability correlates very highly with learnability." Vivid imagery from metaphor "encourages memorability" and "generates...more insightful understanding." (pp. 50-51)

5. Choose a metaphor about which learners have some prior knowledge.

Author: Rogers, Carl R.

Publication: Freedom to Learn.   Columbus, Ohio: Merrill Publishing, 1969.

Classification of Strategies Prescribed

Functions: Outcomes:	Organizational						Managmt	Delivry
	Micro		Macro					
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
Intel. Skills — concept							1,2,3 4,5,6 7	
Intel. Skills — procedr								
Intel. Skills — princpl								
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the following kinds of problems:

Motivation									

        utility

        flexibility

Feasibility: cost-effic.

        adaptability

        implemntblty

Other

Rogers

1. Provide guidance only to those students that desire it because the only learning which significantly influences behavior is self-discovered, self-appropriated learning.

2. Provide guidance and structure only until student is able to handle more freedom because in the end real learning must be self-initiated.

3. Help students to utilize their own drives and purposes as the moving force behind their learning. Learning takes place when students are confronted by issues and problems that have meaning and relevance for them.

4. Make the widest range of resources available to learners. The instructor should think of himself as being one of the most important resources.

5. Create an atmosphere of trust and acceptance by accepting all student responses whether they have intellectual content or demonstrate emotional attitudes.

6. Take role of a participant learner as the acceptant classroom climate becomes established.

7. Bring disruptive interpersonal attitudes of students into open for constructive understanding and use by the group.

Classification of Strategies Prescribed

| Functions:
Outcomes: | Organizational | | | | | | Managmt | Delivry |
| | Micro | | Macro | | | | | |
	PPF	SPF	Sel	Seq	Syn	Sum		
Verbal Information								
Intel. Skills — concept		1						
Intel. Skills — procedr		2						
Intel. Skills — princpl								
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation										

        utility

        flexibility

Feasibility: cost-effic.

        adaptability

        implemntblty

Other

Rothkopf

Comments:

1. Disparity describes the relationship between a potentially instructive event and the performance goal of instruction. It describes the information transformation that the student has to perform in order to be successful.

Prescriptions:

1. To increase the effectiveness of instruction, reduce the disparity between instructive events and target competence.

2. Use familiar informational elements in the insructive stimulus, to reduce the cognitive burdens of transforming the instructive information.

Classification of Strategies Prescribed

Functions: / Outcomes:	Organizational Micro PPF	SPF	Sel	Macro Seq	Syn	Sum	Managmt	Delivry
Verbal Information								
Intel. Skills — concept				2			1	
Intel. Skills — procedr		3 4	1,4,5	2			1	
Intel. Skills — princpl								
Cognitive Strategies								
Affective Domain								
Psychomotor Domain								

Also indicate any strategies which are specifically intended to solve the
following kinds of problems:

Motivation									

                utility

                flexibility

Feasibility: cost-effic.

                adaptability

                implemntblty

Other

Scandura

Comments:

1. **Rules** are the representation of all knowledge in the structural learning theory.

2. Success on any path of a rule implies success on all atomic components. (p. 13)

3. The theory is concerned with (a) the specification of what must be learned, (b) the characterization of cognitive essentials of individual learners and (c) the ongoing and goal-directed interactional process between teacher and learner. (p. 22)

4. There is only a finite number of behaviorally distinct paths through a rule. We do not distinguish paths according to the number of repetitions of loops, because the same cognitive operations and decisions are required regardless of how many times a given loop is traversed in carrying out a given "cognitive computation". (p. 25)

Prescriptions:

1. Select the instructional content for individual students. This is done on the basis of the following criteria:
   a. Considering that all content is conceived of as rules, the rules selected should include only those needed for solving each of the problems in a representative sample of problems associated with the educational goal in question. (pp. 6-7)
   b. Each such rule should include all of the steps (operations and decisions) involved in solving the subset of problems represented by its prototypical problem. (pp. 7-8)

    c. Each of the operations must be atomic in that, for each student in the target population, the ability to correctly use the operation once is indicative of uniform success in using that operation. (p. 8)

    d. The rules and steps of rules which are presented to the student should include only those which the student does not already know. (pp. 10-12)

2. When there is a complex rule that the student does not already know, teach the simpler prototypes (partial rules representing what the student knows) first, and gradually "elaborate" or add increasing detail until the student has mastered the entire rule. (p. 12)

1. & 2. In summary, instruction should consist of presenting exactly those components that diagnosis shows to be lacking, and presenting them in an order consistent with the natural hierarcical ordering of paths. (p. 16)

3. Present instances which vary maximally over the domain of the rule. (p. 15)

4. Describe the competence rules on a <u>level of detail</u> which is commensurate with the entering capabilities of the student population. (p. 27)

5. To improve far transfer, identify and teach "higher-order" rules, that is, rules which the student can use to generate appropriate rules of competence.

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